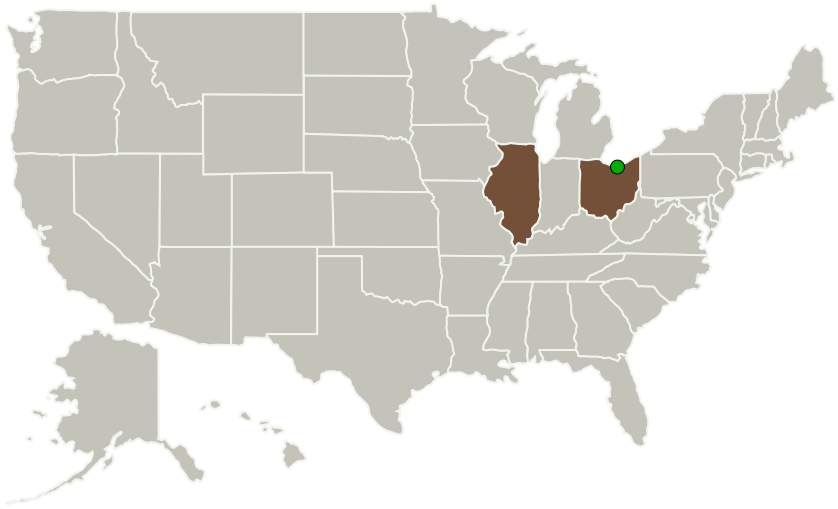
Reconfigurable VLIW Processor for Software Defined Radio, Phase II

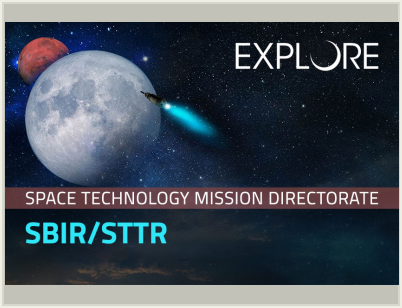
Completed Technology Project (2011 - 2014)

Project Introduction

We will implement an environment for design, formal verification, compilation of code, and performance and power evaluation of Systems on a Chip (SOCs) consisting of heterogeneous processor cores that can be single-issue pipelined, superscalar, or VLIW, and are binary-code compatible with any existing Instruction Set Architecture (ISA). Particularly, we will ensure binary-code compatibility with the PowerPC 750 ISA, which is used in the radiation-hardened RAD750 flight-control computer that is utilized in many NASA space missions, including Deep Impact, the Mars Reconnaissance Orbiter, the Mars Rovers, and is planned to be used in the Crew Exploration Vehicle (CEV). The processor cores will have reconfigurable functional units and corresponding specialized instructions that can be optimized to accelerate any application. Our focus in this Phase 2 project will be on Software Defined Radio (SDR) applications. The radiation-hardening will be done at the microarchitectural level with a mechanism that will allow the detection and correction of all timing errors---caused not only by radiation, but also by variations in the voltage, frequency, manufacturing process, and aging of the chip. The binary-code compatibility of the processor cores with the PowerPC 750 ISA will allow them to seamlessly execute legacy binary code from previous space missions. We have made critical contributions to the fields of formal verification of complex pipelined microprocessors, and Boolean Satisfiability (SAT), and have developed highly efficient Electronic Design Automation (EDA) tools that we will use.

Primary U.S. Work Locations and Key Partners





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Completed Technology Project (2011 - 2014)

Organizations Performing Work	Role	Type	Location
Aries Design Automation, LLC	Lead Organization	Industry	Chicago, Illinois
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Illinois	Ohio

Project Transitions

June 2011: Project Start

April 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139274)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Aries Design Automation, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Miroslav N Velev

Co-Investigator:

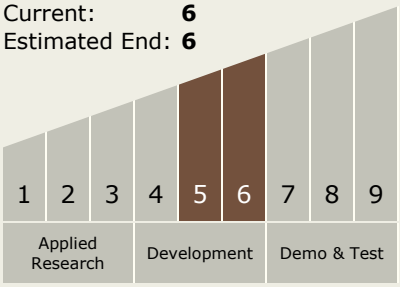
Miroslav Velev

Reconfigurable VLIW Processor for Software Defined Radio, Phase II

Completed Technology Project (2011 - 2014)

Technology Maturity (TRL)

Start: **5**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.2 Radio Frequency
    - TX05.2.4 Flight and Ground Systems

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System